Space Weather Technical Forecast

Issued on Wednesday, 07 February 2024 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares expected, with a chance of isolated X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate, with the peak flare a M4.2 at 06/0312UTC from AR3575, which was associated with type II and type IV radio emissions. There are ten sunspot regions however most of these are small and either stable or fading with only two of particular note. AR3576 is a large and active region on the southeast disc, with a complex but ragged main leader including a strong delta spot and significant magnetic looping evident in SDO imagery. AR3575 is a smaller but still complex and active region in the southwest disc, which is becoming hard to assess due to both its southern and western location, however this consists of two main opposite polarity umbrae within a combined penumbra, leading to a further delta-configuration.

Further analysis of the CME that left the Sun in association with the M4.2 flare from AR3575 gives a reduced potential for a glancing blow into the 09 February. The large Halo CME visible on coronagraph imagery from around 06/1200 UTC has been assessed as far-sided, though analysis and modeling of a narrow filament liftoff from the center northern disk at a similar time is ongoing.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1 were indicative of a fast wind, likely from CH96/+ and possible weak transient influence, solar winds slightly elevated at just under 500km/s for much of the period with a recent slight reduction down towards 430-460km/s. Density was mostly average throughout. Interplanetary Magnetic field (IMF), Bt, was weak to moderate at 5-9nT. The north-south component Bz, has varied between +7nT and -6nT, but been broadly positive. Phi angle was also mostly positive (away from the Sun). Geomagnetic activity was mostly Quiet (Kp0-2), with an Unsettled (Kp3) interval in the early hours of the UTC day 06 February.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux became slightly elevated following the M-class flare early on the 06 February but remained below the S1 threshold and has slowly returned towards background. GOES16 high energy (greater than 2MeV) electron flux was at background. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. At 07/0000UTC the 24-hour integrated fluence observation was 1.27e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity expected, with further M-flares expected and an initial chance of X-flares. These most likely from either AR3576 in the southeast, or from AR3575 in the southwest, although this risk decreases slightly day 2 onward as AR3575 recedes on the far-side.

Solar Wind / Geomagnetic Activity: Current fast winds from CH96 are expected to gradually

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ease through day 1 (07 February), with slightly elevated speeds easing towards background.

The CME that left the Sun in association with the M4.2 flare in the morning of 06 February may provide a slight glancing blow late into day 3 (09 February), but the risk of significant impacts has been reduced. Geomagnetic activity is expected to be mostly Quiet to Unsettled.

Energetic Particles / Solar Radiation: High energy proton flux has the potential to rise in response to any significant flares, most likely from AR3575 at first, but increasingly from AR3576 as this moves into a more central location. This brings a slight chance of exceeding the S1 Minor Radiation Storm level. High energy electron flux (greater than 2MeV) is expected to remain mostly at background with the associated 24 hour fluence persisting below the Active threshold.

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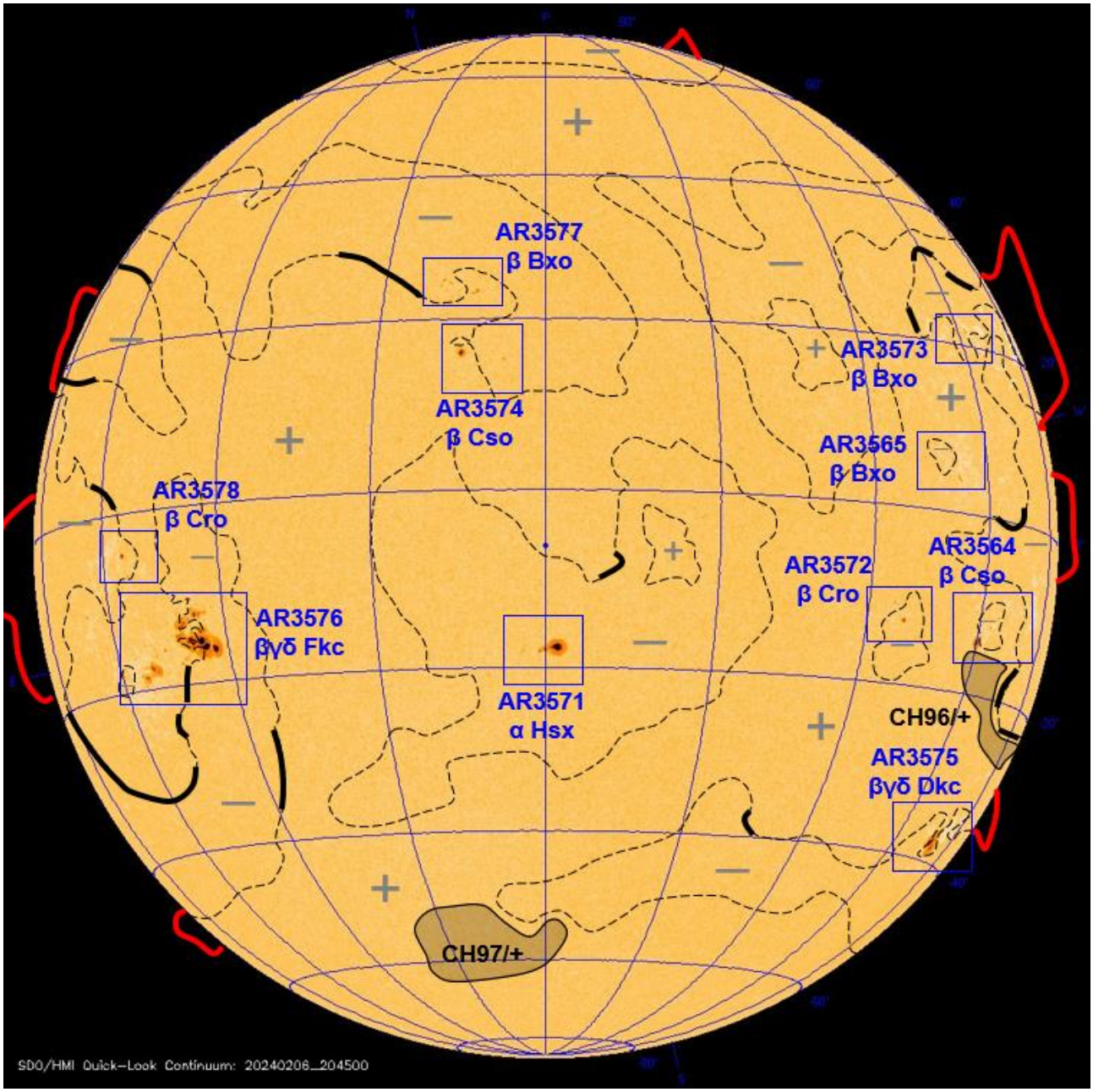
Figure 1. Solar Analysis Valid 06/2045UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

Ongoing fast wind from small and now largely obscured coronal hole 96 is expected to gradually ease through day 1 (07 Feb), with solar winds falling from slightly elevated around 450-480km/s towards background, below 400 km/s. The CME that left the Sun in association with the M4.2 flare in the morning of 06 February may provide a glancing blow late into day 3 (09 February), bringing a very slight chance of G1, but the risk of significant impacts has been reduced.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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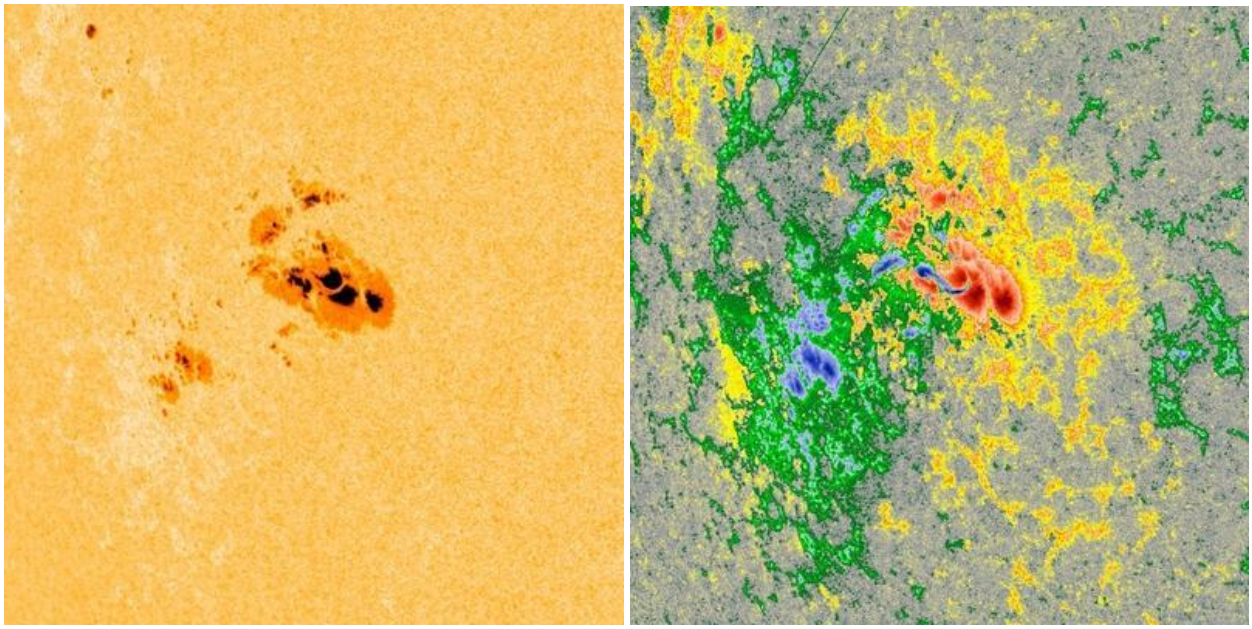
Radio Blackouts - X-Ray Flares:
Moderate solar activity is expected to continue with a chance of rising to High due to isolated X-class flares. The main risks for flaring are from AR3576 in the southeast and AR3575 approaching the southwest limb. The majority of other regions on the disc are small, stable and simple with some of these spots showing signs of fading.

AR3576 is a large region in the far southeast disc, this region has a strong delta within its main leader spots, with a broad area of looping evident in SDO-aia imagery. Along with an identifiable flux-rope and ongoing dynamical changes, this suggests the ongoing risk of notable flares. AR3575, while smaller, produced the recent M4.2 flare early on 06 February, and also has a visible delta spot, along with evidence of magnetic looping building within its canopy. Furthermore, any apparent reduction in spot area may be due to its southern location, along with it approaching the western limb leading to an oblique viewing angle. It is due to rotate over the southwest horizon early day 2 (08 Feb), with a consequent slight decrease in flare risk.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	70	70	70
Very Active	R3 to R5 X Class	No	25	20	20	20

Figure 2: Recent imagery for AR3576, displaying complex magnetic structure and delta spot.



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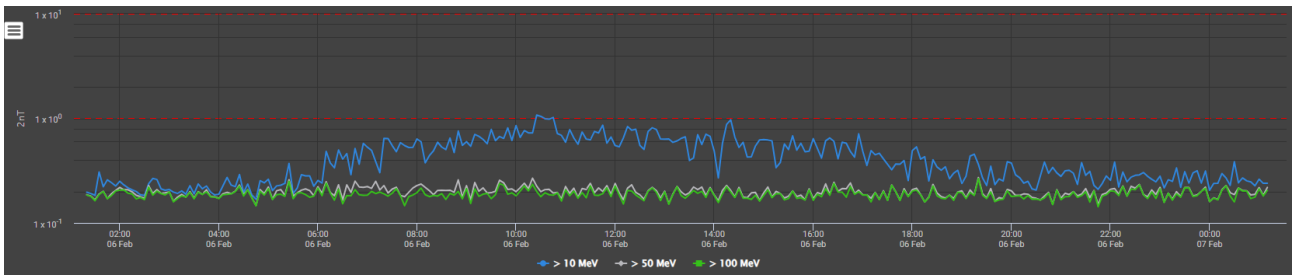
Solar Radiation Storms - (High Energy Protons):
GOES18 high energy (greater than 10MeV) proton flux is currently returning to background levels after the earlier response to the M4.2 flare, which remained well below the S1 threshold. There is a risk of proton flux rising in response to any further notable flares, with a slight chance of exceeding the S1 Minor Radiation storm level. Initially the main risk is from AR3575, due to its position in the southwest of the disc, with the risk persisting as this moves over the western horizon early day 2 (07 Dec) before gradually reducing. However, AR3576, which is currently in the eastern disc, will have moved to a more central disc location by this time, increasing the potential for proton events occurring due to any notable flares from this region resulting in a generally stable risk throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 3: Latest 24hr GOES18 Proton Flux trace.



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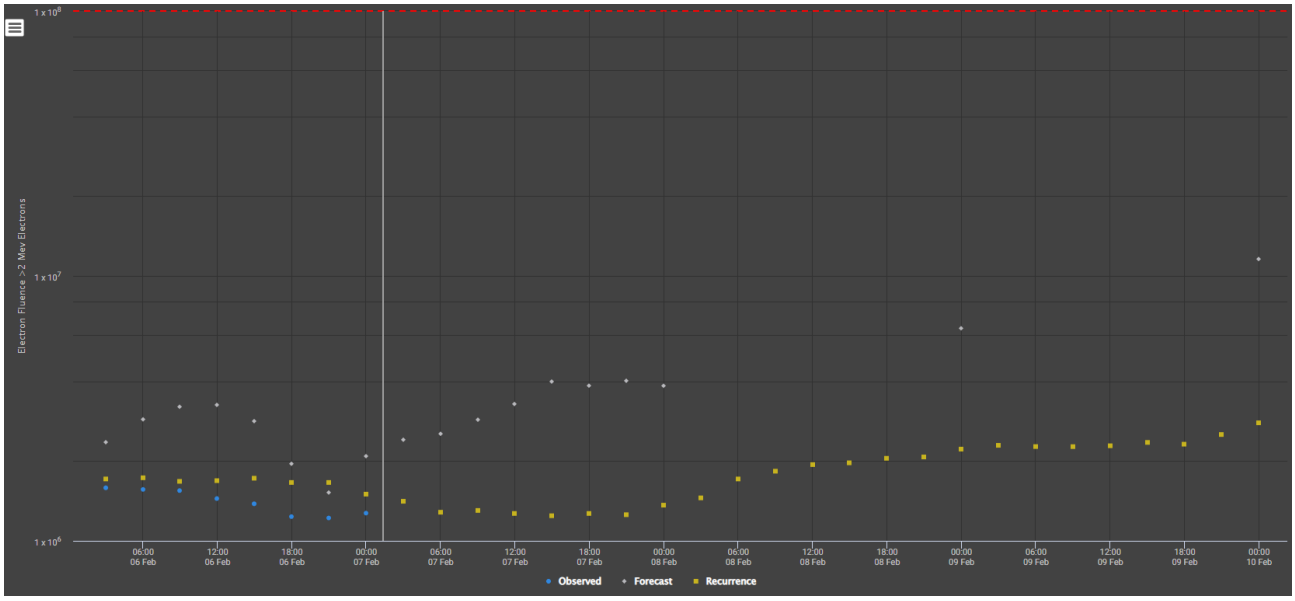
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) as observed by GOES-16 is expected to persist at background levels, with the current fast wind enhancement thought unlikely to bring a notable increase in electron flux. There is a slight chance of brief Moderate flux day 2 (08 Feb) onward during the diurnal peak.

The associated 24 hour electron fluence is expected to remain well below the Active (1e8 integrated flux) threshold, as suggested by MOSWOC's REFM, which is currently thought to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model output.



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